PHENIX EMC Energy Calibrations

sPHENIX Simulations Workshop
7/30/15

Jeffery T. Mitchell
(Brookhaven National Laboratory)

EMC Calibration Steps

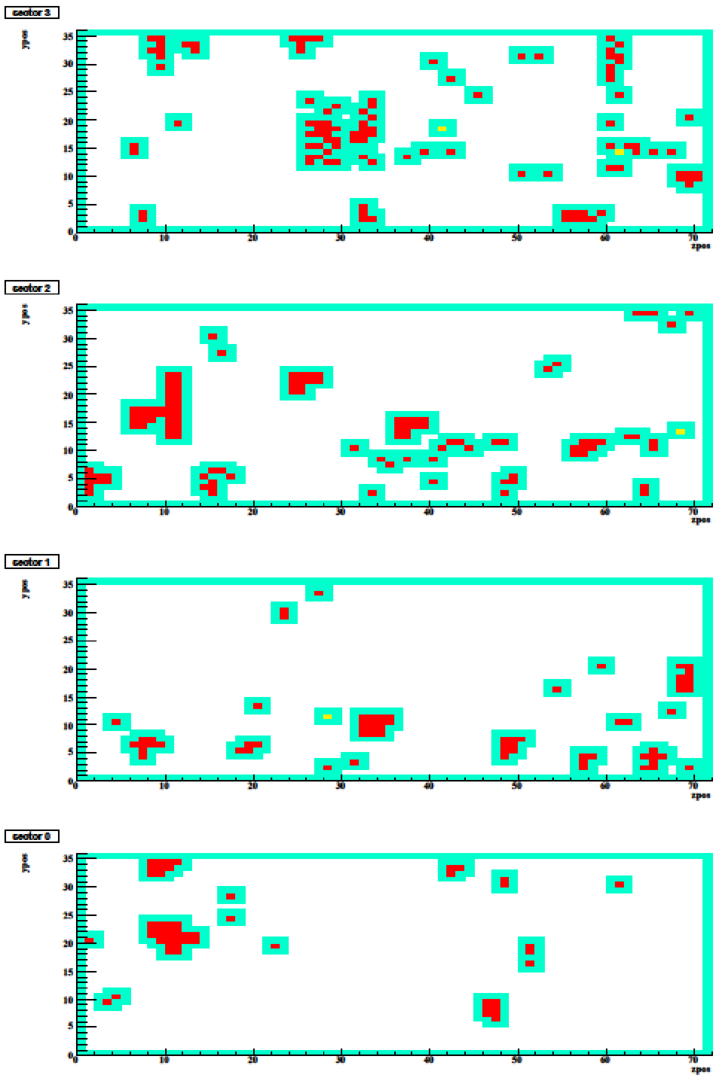
- Create EMC calibration-specific ntuples from EMC-only PRDFs.
- Generate a dead/warnmap
- Perform a tower-by-tower calibration by reconstructing pi0's in each tower.
- Iterate the reconstruction until it converges for as many towers as possible.
- Commit the resulting coefficients to the database.
- Analyzers are asked to check the calibrations.
- Calibrations for some of the bad towers can be recovered using a slope calibration method.
- Note: This is a legacy calibration procedure dating way back to Run-3. It is certainly not optimal and can be improved for sPHENIX.

Generating dead/warnmaps

- The first step is to produce EMC-only PRDFs. This is done by Chris in 1008 and then transferred to the RCF. These PRDFs can also be produced by production at the RCF.
- The calibration uses legacy software that runs off of ntuples. So, the next step is to generate the ntuples from the PRDFs. Everything step after this runs off the ntuples.
- Dead/warnmaps are generated by making hit frequency distributions for 5 ecore ranges (0.2-0.3, 0.3-0.5, 0.5-1.0, 1.0-1.5, 5.0-30 GeV). Plot tower numbers vs. number of hits.
- Hot towers are tagged if the hit frequency in a tower is 8 sigma (PbSc) and 15 sigma (PbGl) above the mean frequency.
- Dead towers are tagged as towers with no hits.

- The plots shown in this presentation are from the Run-15 calibration.

Warnmap Results, Arm 0



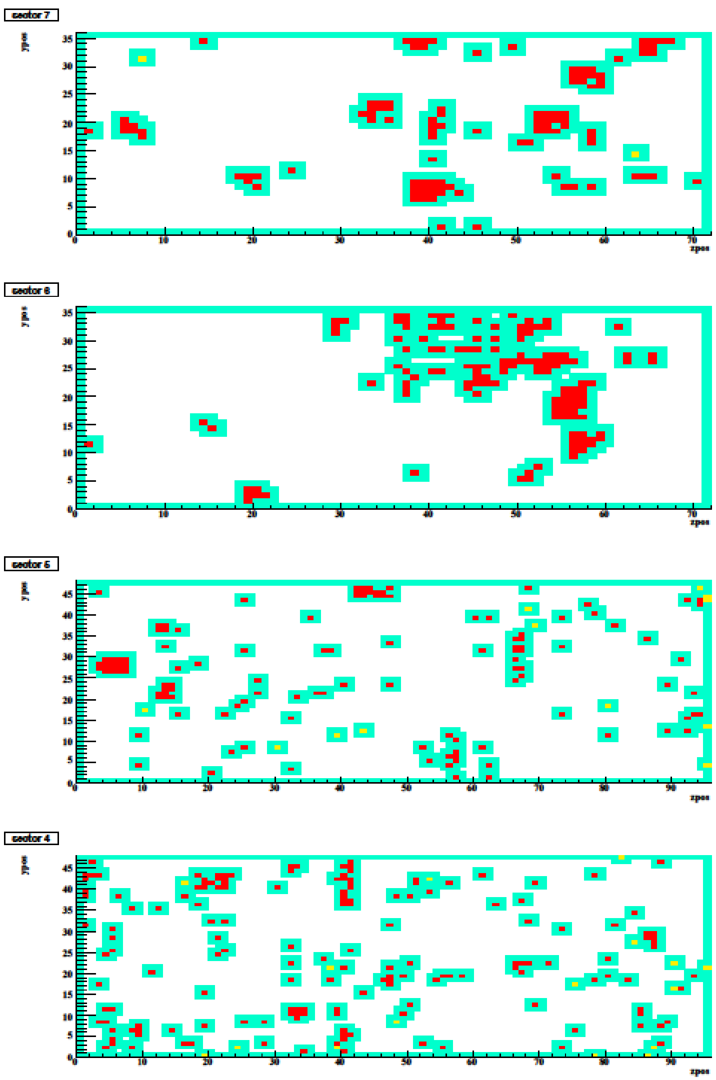
Red = hot/dead tower

Cyan = region around the hot/dead towers

All plots are PbSc sectors.

These maps are comparable to the Run-13 510 GeV p+p maps.

Warnmap Results, Arm 1



Red = hot/dead tower

Cyan = region around the hot/dead towers

The bottom 2 plots are the PbGl sectors.

The PbSc maps are comparable to the Run-13 p+p maps.

The PbGl maps are comparable to the Run-14 maps.

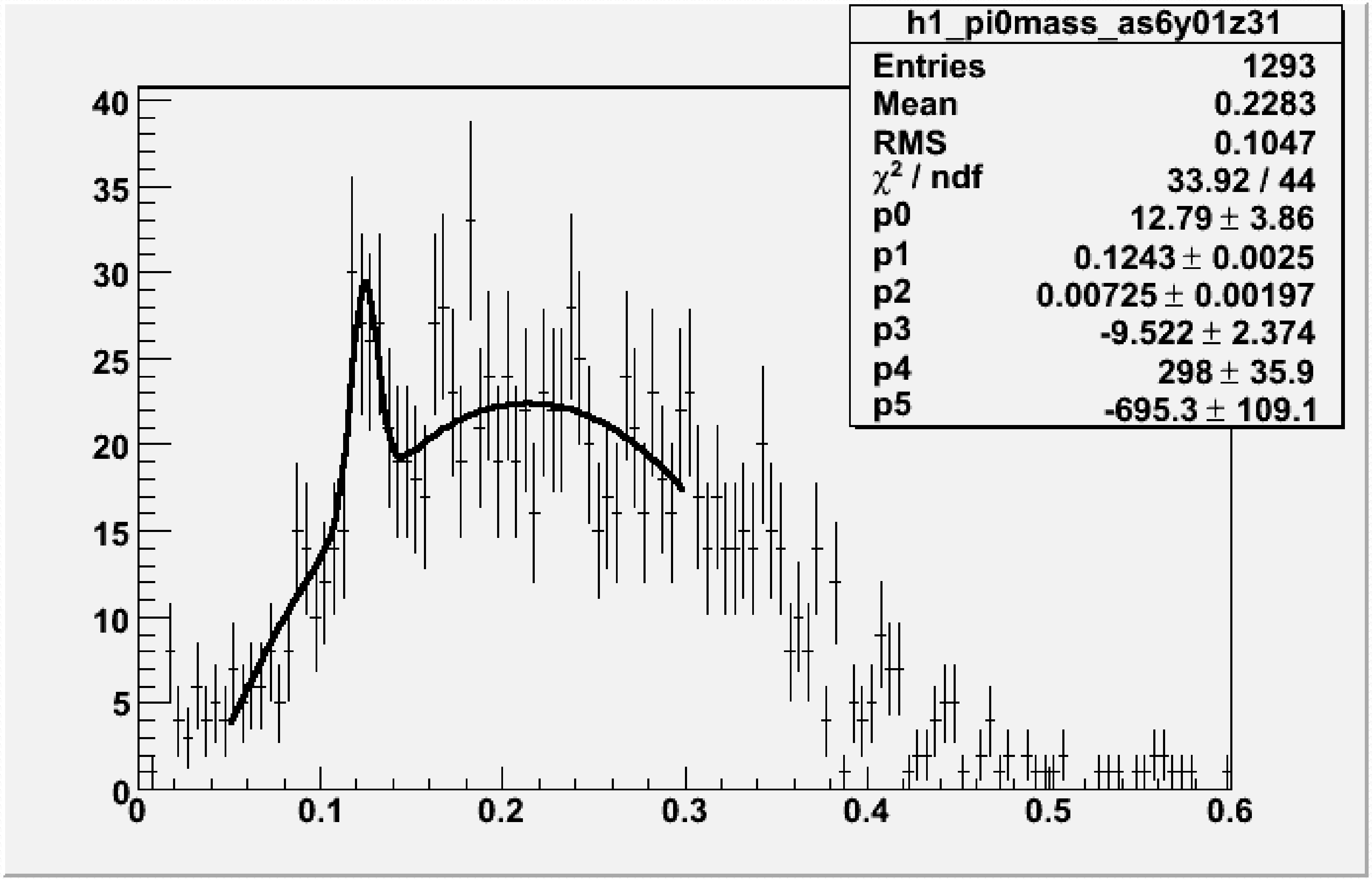
The higher hot/dead density of the PbGl sectors is consistent with previous runs.

Pi0 Fit Method

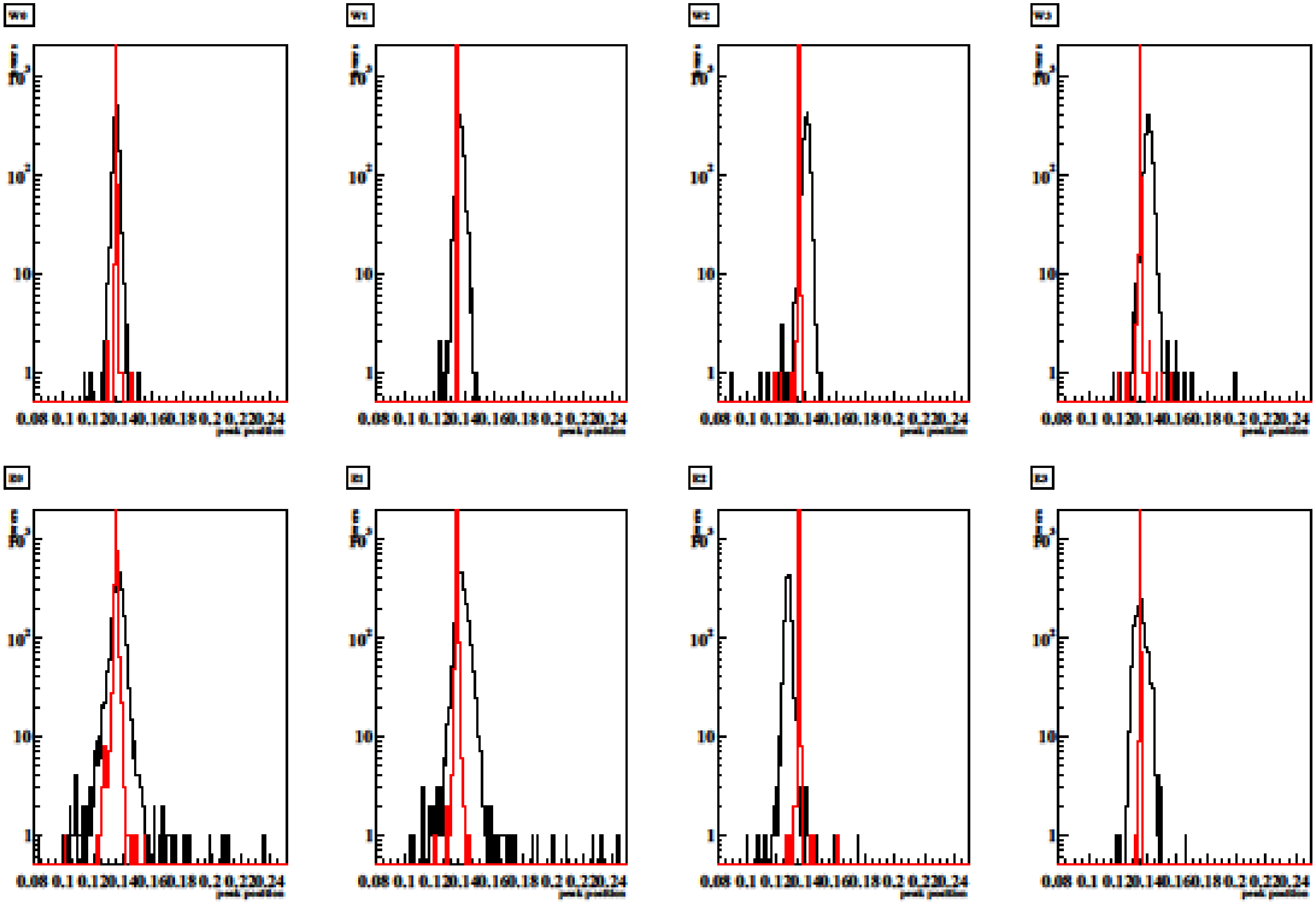
- Calculate the invariant mass of cluster pairs in an events. Shift pi0 peak of every tower to 135 MeV.
- Cuts:
  - Cluster chi2 < 3;
  - min pT in target tower: >0.8 GeV
  - min pT in associated tower: >0.2 GeV
  - min pT of the pair: > 1.0 GeV
  - asymmetry cut: <0.8;
  - Event centrality > 40% for Au+Au
- Fit the pi0 peaks of 25000 towers with gaussian + polynomial function. The energy scale factor is calculated by c = 135MeV/peak mean.
- Every iteration reads in the correction factors from previous iteration, and apply the correction to every tower in every cluster, and then iterates above steps.
- Typically 6-7 iterations are necessary. An iteration takes about 4 hours.

- This is handled by a macro that checks fits for goodness and prompts the user to look at questionable fits by eye. Lately, ~400 towers need an eye check.

An example fit



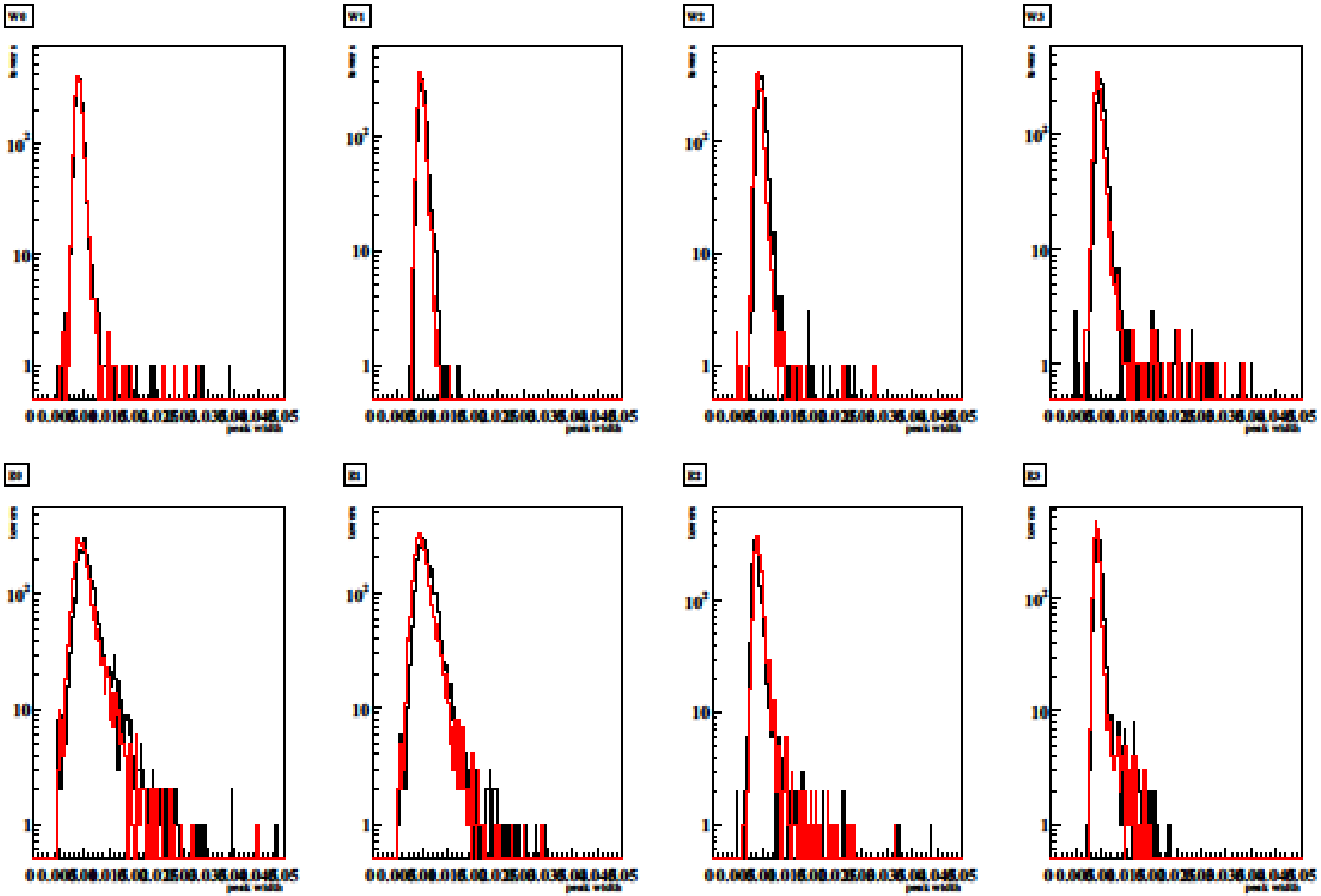
Tower-by-tower mean



Black = iteration 0

Red = iteration 8

Tower-by-tower sigma

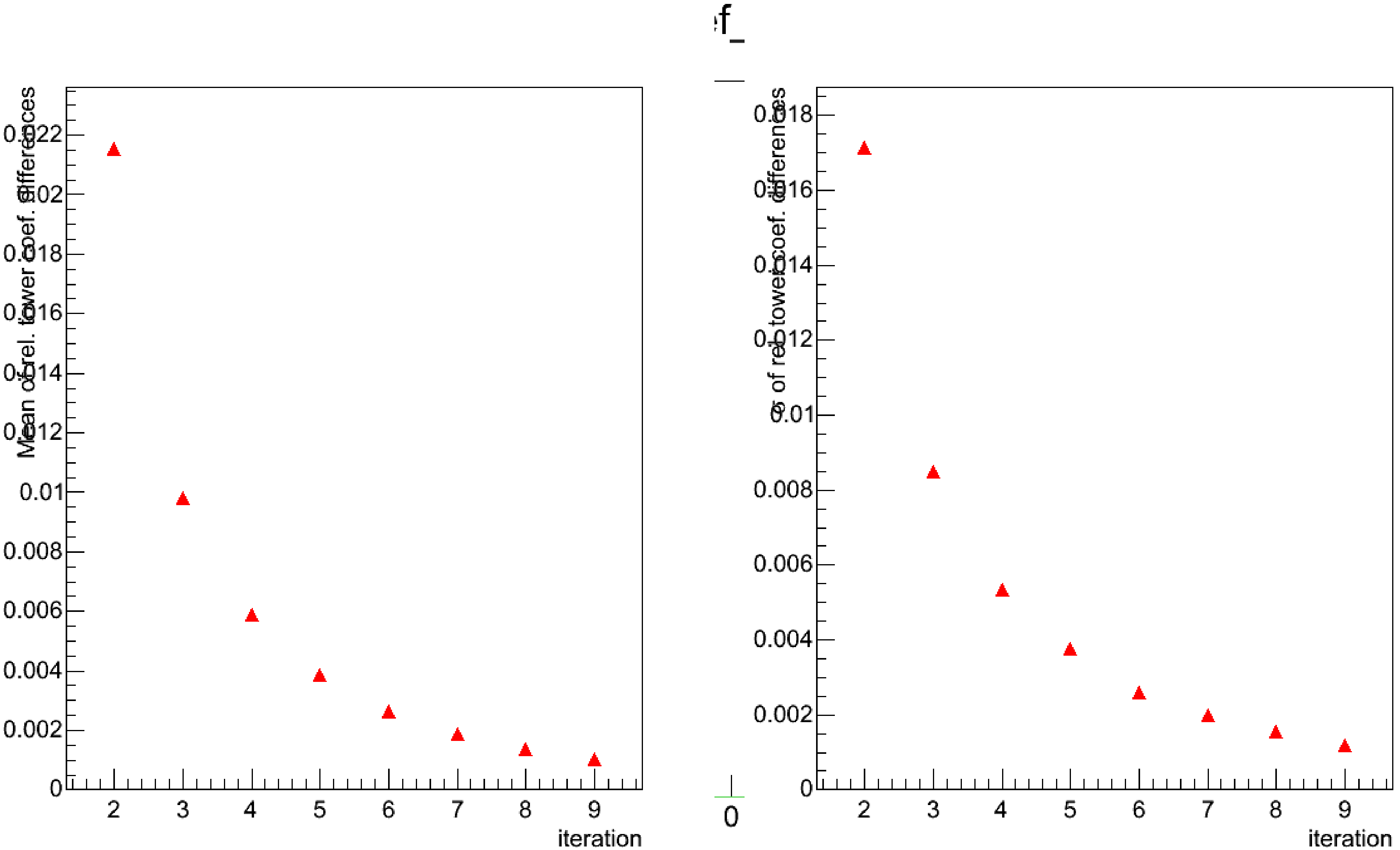


Black = iteration 0

Red = iteration 8

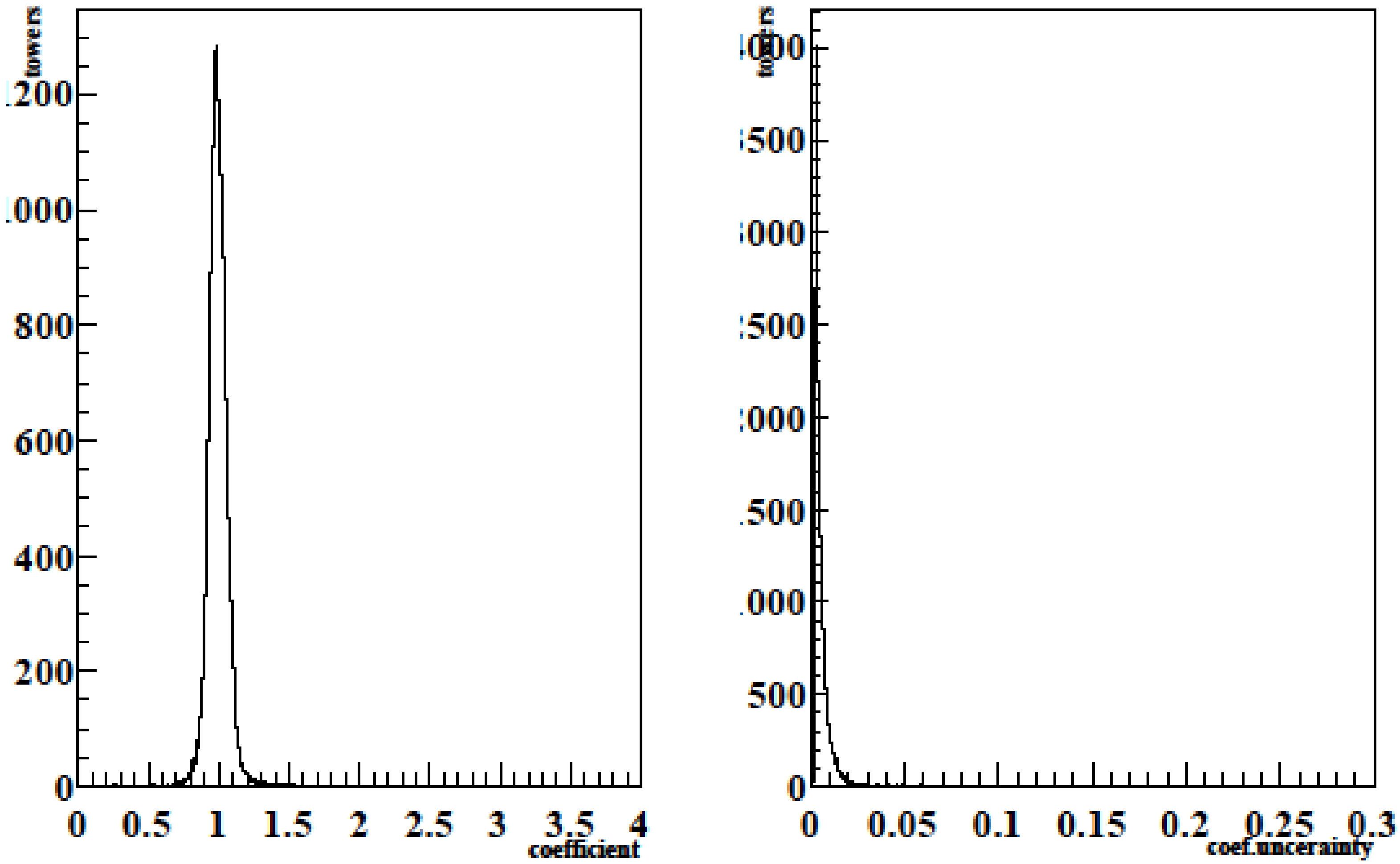
Convergence

Good convergence. More iterations won't do much better.

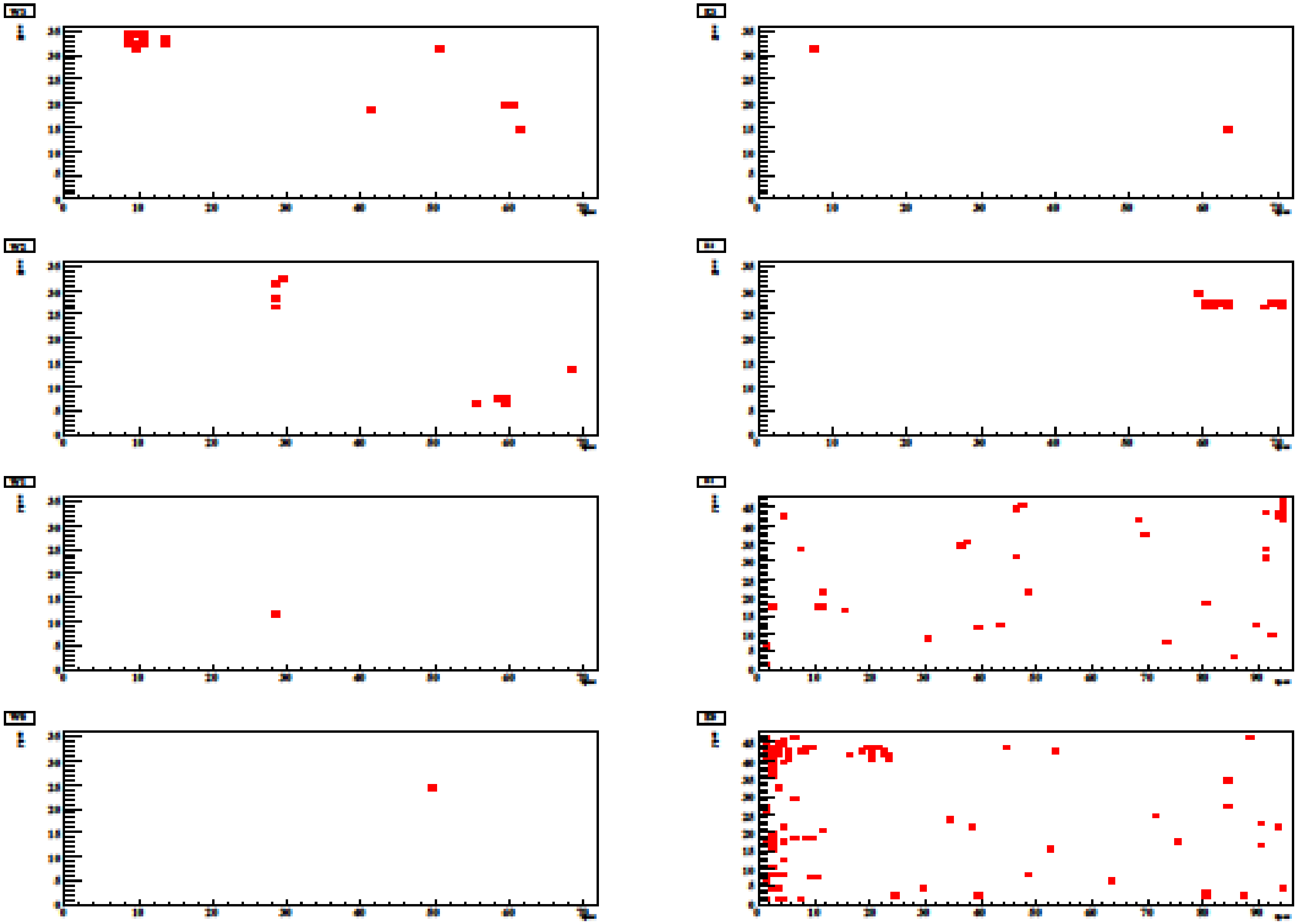


Coefficients

The spread in the coefficient distribution is consistent with Run-13 and Run-14.



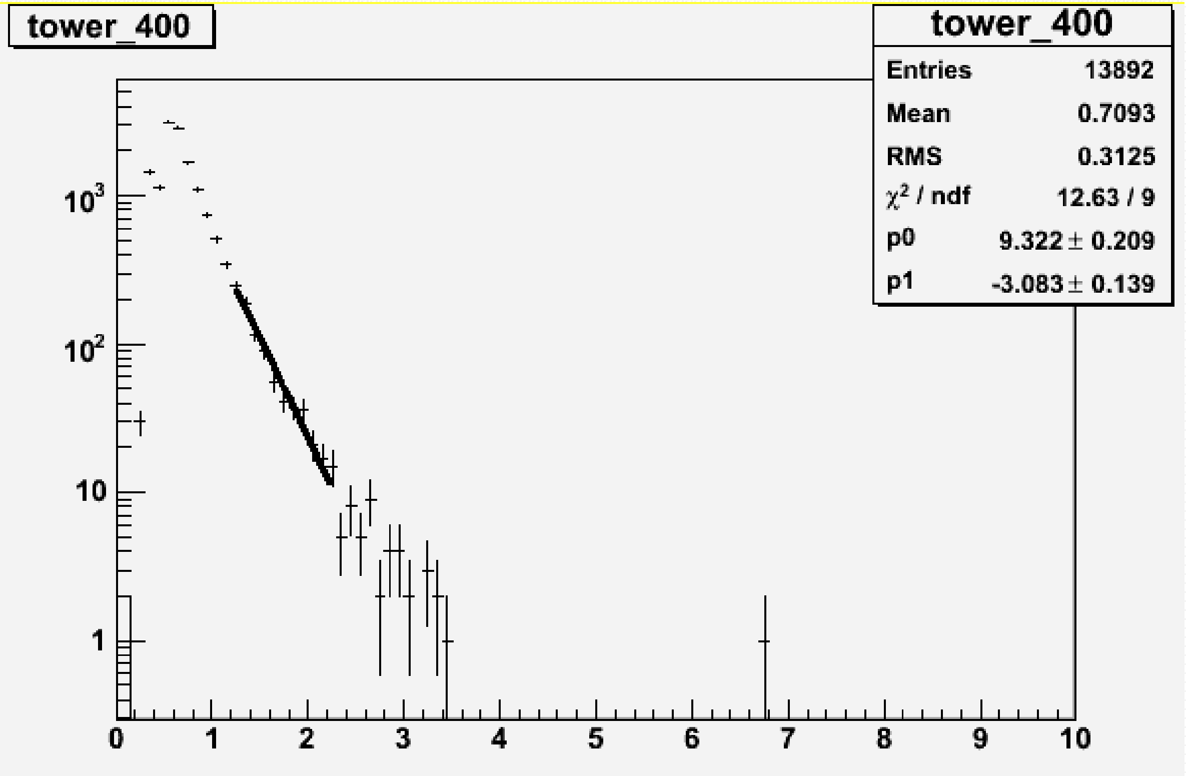
Uncalibrated Towers



There are fewer uncalibrated towers than for Run-13 or Run-14.

Most of the uncalibrated PbGl towers are rejected due to no peak, not due to low statistics.

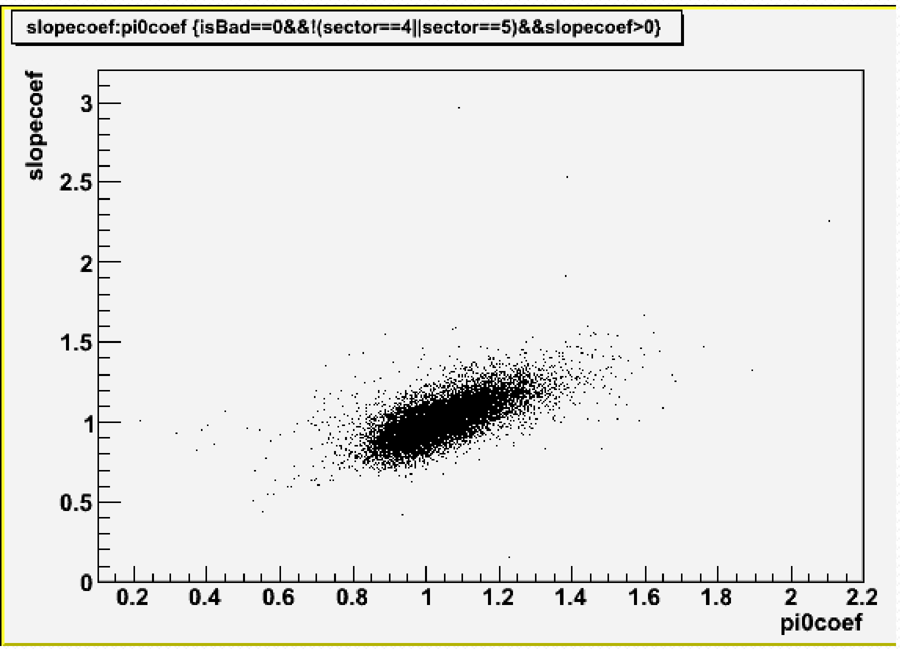
Slope Calibration Method



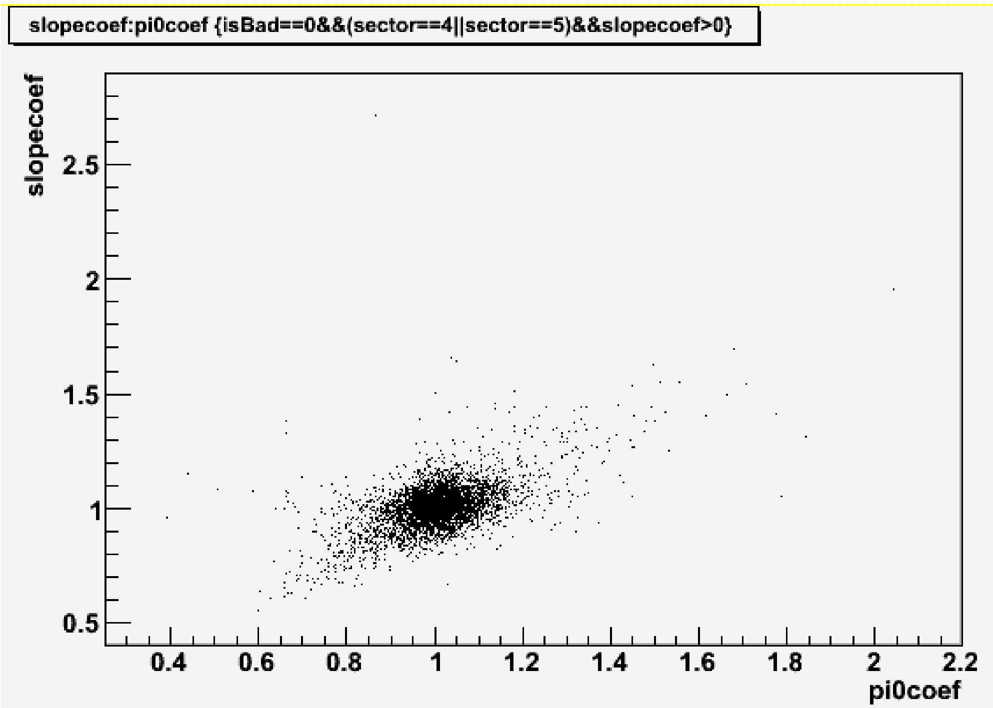
- Fit each tower's ecore distribution with exponential function: f(ecore) = p0*exp(p1*ecore)
- Invere slope = 1/p1 is the average energy.

Comparing Methods

This comparison is shown with good towers, which passed cut and eye checking



PbSc



PbGl

They show good correlation.

Summary

The PHENIX EMC calibration was kludged together in a run-by-run metamorphosis by a different person calibrating the data for each run.

With some planning, the calibration procedure can be much better integrated into the sPHENIX software from the beginning.